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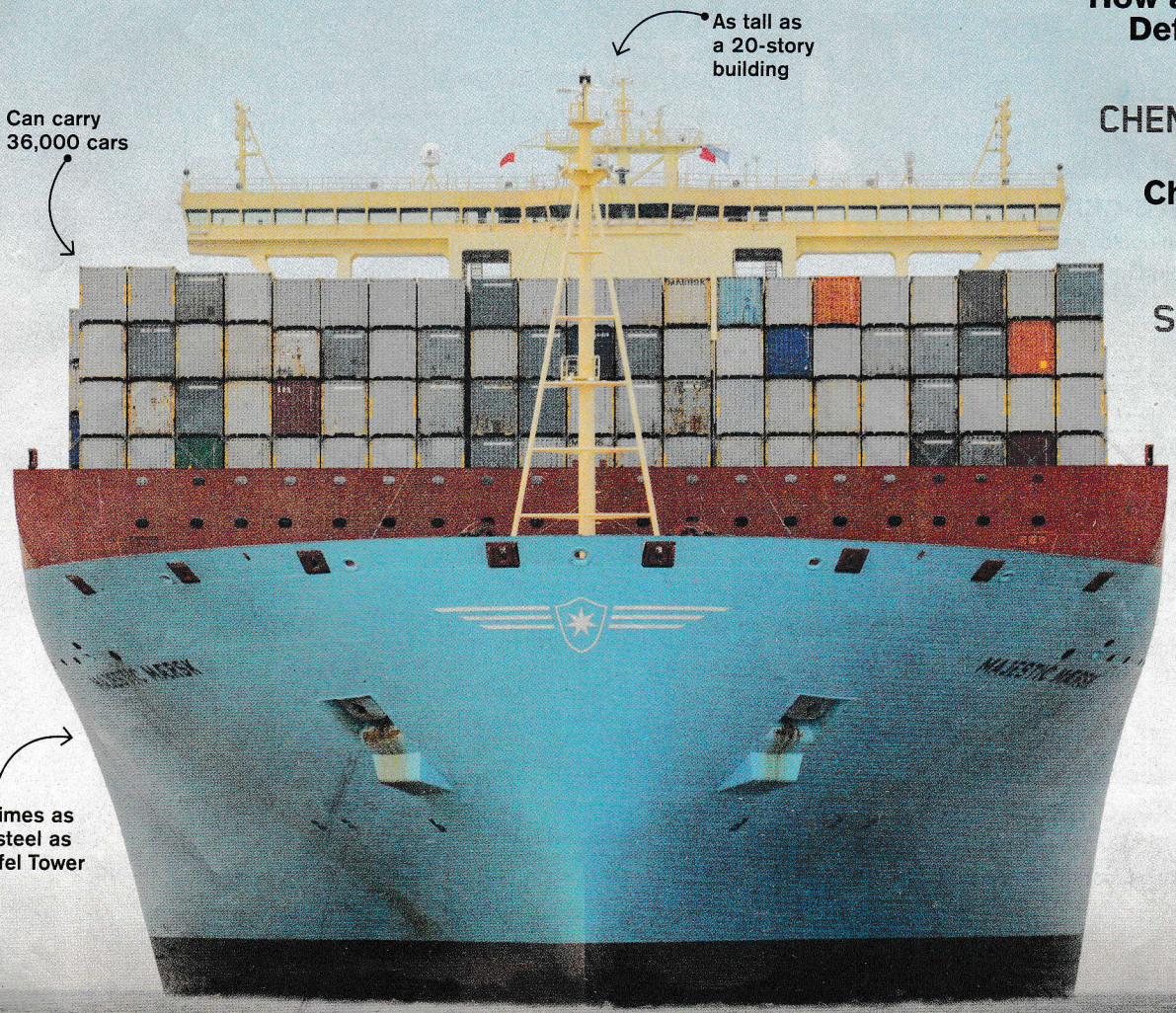

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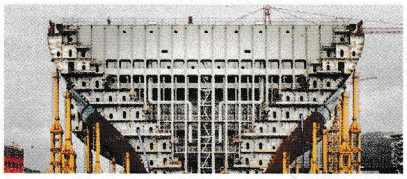

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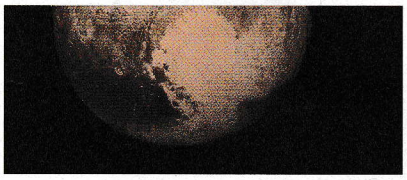

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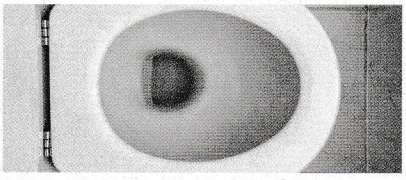

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HIGH FLIER

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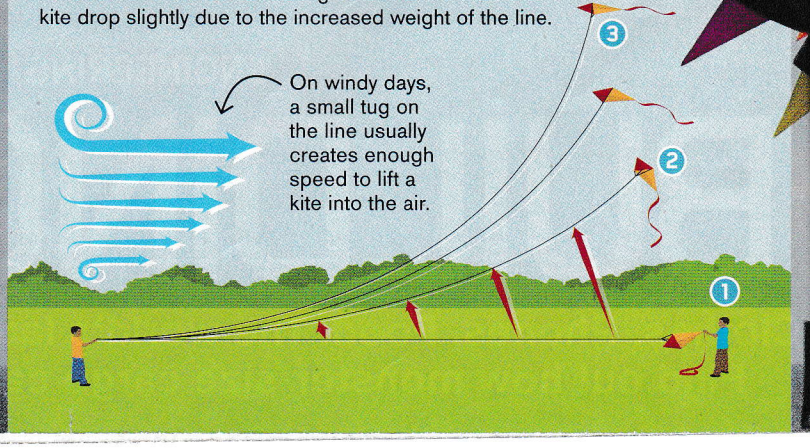

UP AND AWAY: A kite soars at the Souter Lighthouse Kite Festival in England.

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FLYING CHILI LTD. (DIAGRAM); PAUL KINGSTON/NORTH NEWS & PICTURES LTD (KITE)

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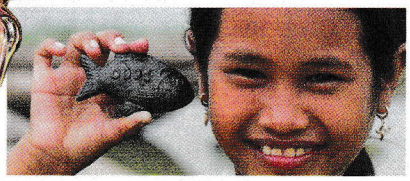

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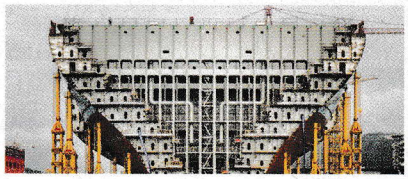

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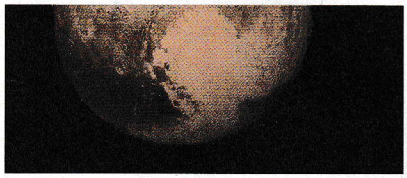

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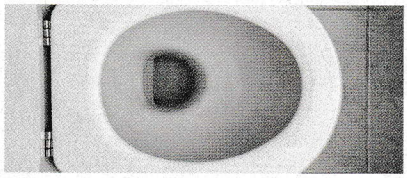

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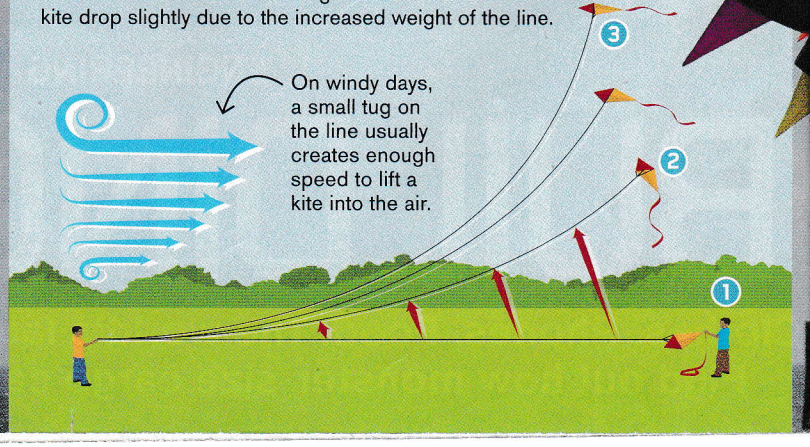


BIOLOGY: HEALTH

TRIX'S NEW LOOK

General Mills, the company that creates cereals like Lucky Charms and Trix, announced that by the end of 2016, all-natural ingredients will replace artificial colors and flavors in more than 90 percent of its cereals.

Artificial colors come from chemicals that aren't taken from a plant, spice, or other natural substance. Studies have linked artificial colors to conditions like hyperactivity in some kids, which can cause difficulty paying attention in class, says Vandana Sheth, a spokesperson for the Academy of Nutrition and Dietetics.

General Mills says the cereals will now get their color primarily from fruit and vegetable juices and spice extracts. Updating marshmallow colors has proved to be especially tricky, so Lucky Charms will get the upgrade last. "We want to make sure that the cereals will taste just as good as they do today," says Kate Gallager, a General Mills cereal developer. *—Jennifer Abbasi*

TRIX NOW
General Mills is replacing artificial colors and flavors in Trix cereal. This is how Trix will look until early next year.

BLUE AND GREEN
Blue and green Trix both contain the chemicals Blue 1, Yellow 6, and Red 40.

YELLOW AND ORANGE
The chemical Yellow 6—which helps create Trix's yellow and orange hues—will be replaced with extracts from the spices turmeric and annatto.

PURPLE
The chemical Blue 1 will be replaced with juice from blueberries and purple carrots.

RED
The chemical Red 40 will be replaced with juice from strawberries and radishes.

FUTURE TRIX
General Mills is eliminating blue and green colors in Trix because it wasn't able to replace the combination of artificial colors with natural ingredients without changing the taste too much.

In the future, Trix will have four colors instead of six. Red, orange, yellow, and purple will remain. Blue and green will be eliminated.

EARTH SCIENCE: SPACE

SPACECRAFT SELFIE

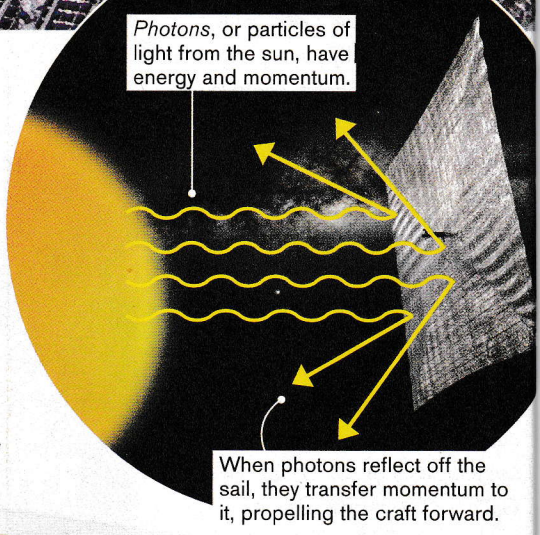
Say cheese! This June, an unmanned spacecraft called LightSail snapped a picture of itself in space and sent it to scientists on Earth. LightSail's selfie revealed that the mission to test its solar technology was successful: The craft stretched out its sails to collect the sun's energy.

LightSail is pushed by energy from the sun. Its shiny, reflective sails act like large mirrors. When sunlight hits them, energy is transferred to the craft. This allows the spacecraft to slowly but steadily "sail" through space.

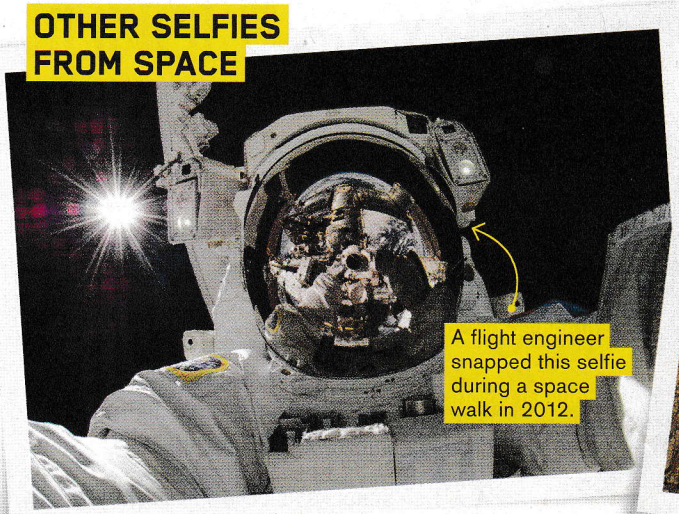
Scientists at the Planetary Society in Pasadena, California, which launched the project, hope to eventually design an inexpensive spacecraft like LightSail that can travel to other planets using only the sun's energy.

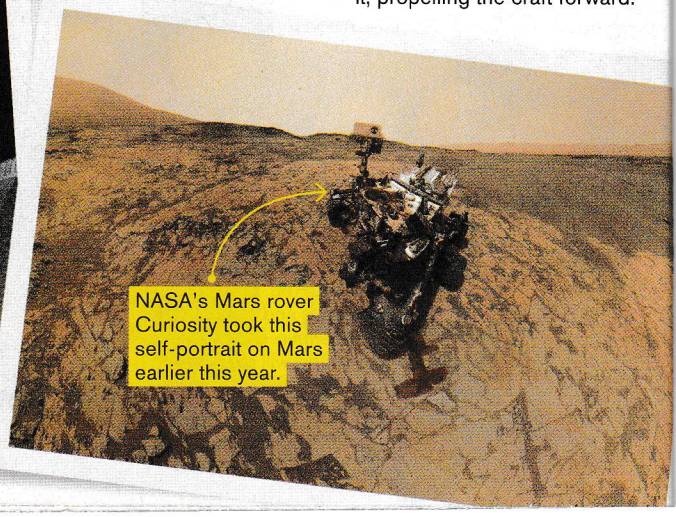
–Claire Maldarelli

HOW LIGHTSAIL WORKS



OTHER SELFIES FROM SPACE





BIOLOGY: ANIMAL BEHAVIOR

CHIMPS IN THE KITCHEN

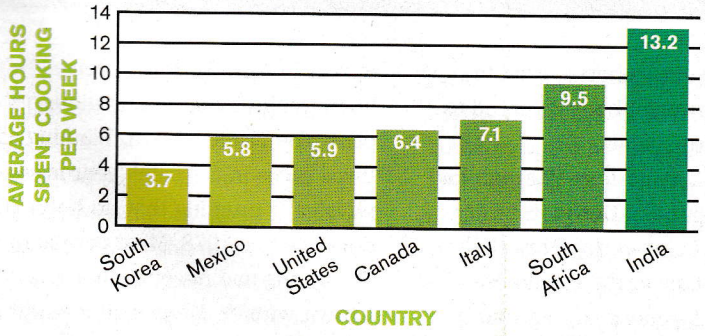
Do chimpanzees like to cook? To find out, Harvard University biologists tried a tasty experiment at a wildlife sanctuary in the Republic of the Congo in Africa.

The scientists offered chimps a choice between raw and cooked sweet potatoes and carrots. They preferred the cooked food. Then the scientists gave the chimpanzees raw vegetables and showed them a container. If the chimps placed the raw food inside, the scientists put a lid on it and shook it. Then scientists opened a secret part of the container and revealed cooked food, creating the illusion that the shaking cooked the food. Again and again, chimps chose to place their food in the container to "cook" it.

"They understood the basic cooking transformation," says Alexandra Rosati, a study leader. Unfortunately, because chimps haven't learned to control fire, they won't be hosting dinner parties. *—Charles C. Hofer*

TIME SPENT COOKING

About how much time do people in the U.S. spend cooking compared with people in India? Name two reasons that people in one country might spend more time cooking than those in another.



SOURCES: STATISTA, GFK

NUMBERS IN THE NEWS

100 trillion
Approximate number of bristlemouth fish in the ocean. They're the world's most numerous vertebrate. Up to thousands of trillions may exist.

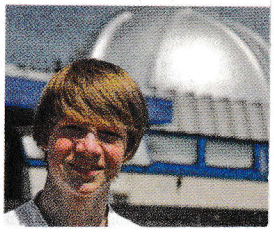
136 billion Number of pages that British scientists estimate it would take to print out the entire Internet.

100,000 Dollars that a recycling company hopes to pay a woman who donated a first-generation Apple computer first sold in 1976. Her name is unknown.

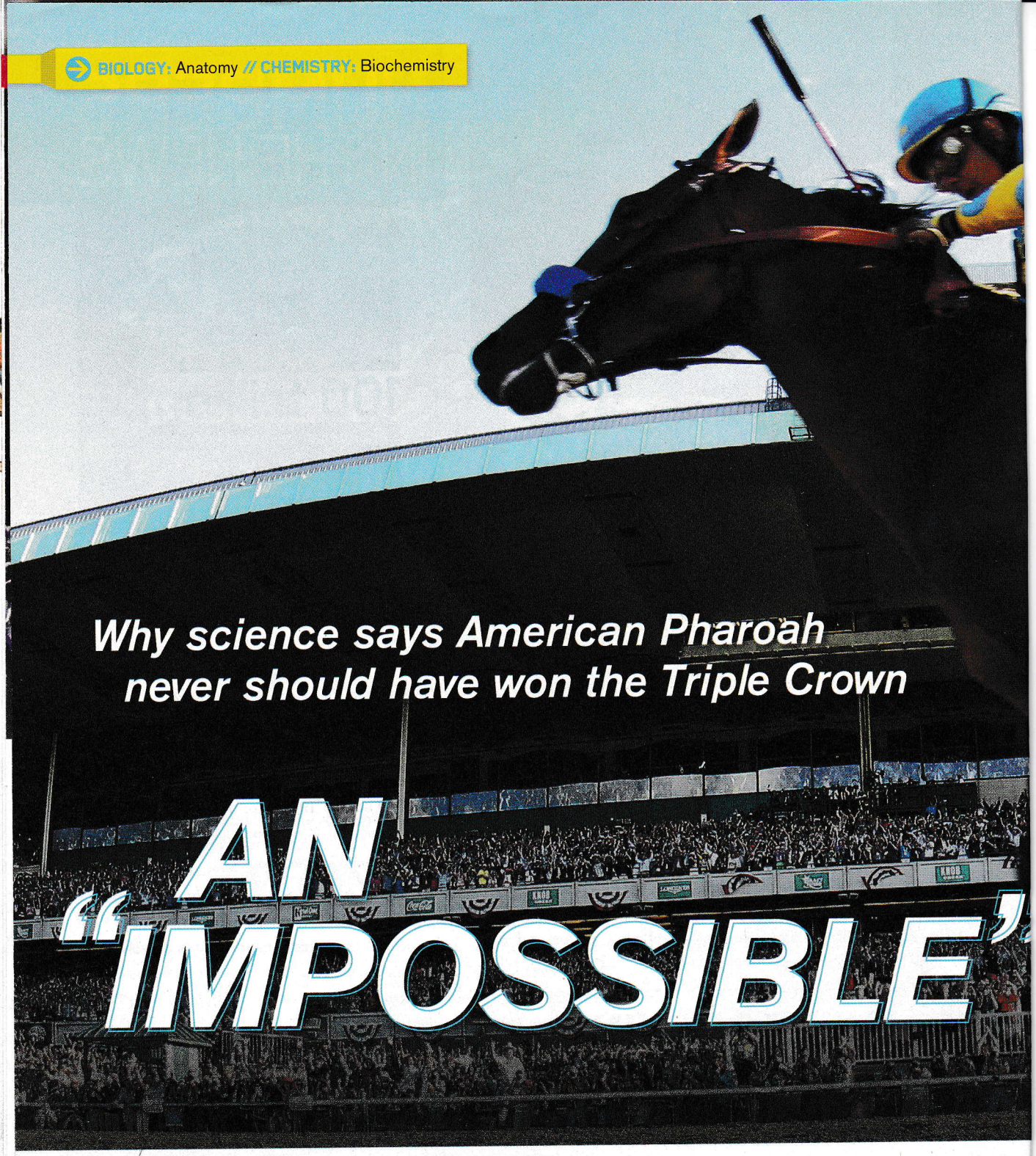
27,000 Number of years ago that dogs split from wolves, according to a new study. Dogs are genetic descendants of wolves.

66 Number of surfers in California who rode a giant surfboard at once. They surfed a wave for 12 seconds.

15 Age at which British teenager Tom Wagg discovered a planet located 1,000 light-years away.



MIRRORPIX/ALAMY (CHIMPS); SOLVIN ZANKL/ALAMY (FISH); MINDY SCHAUER/THE ORANGE COUNTY REGISTER VIA AP PHOTO (SURFBOARD); COURTESY OF TOM WAGG/KEELE UNIVERSITY, UK (WAGG)



Why science says American Pharoah never should have won the Triple Crown

AN "IMPOSSIBLE"

On June 6, sports fans gathered to watch a once-in-a-lifetime athlete compete. At 3 years old and 580 kilograms (1,280 pounds), he stood calmly on the track. His muscles rippled under a shiny reddish-brown coat. The athlete was American Pharoah—a thoroughbred racehorse, bred to have the powerful body required to run at record speeds.

On May 2, American Pharoah had won the Kentucky Derby in a very close race. On a stormy May 16, he took first place at the Preakness in Maryland. American Pharoah needed only to win the Belmont Stakes in New York to receive horse racing's most prestigious prize: the Triple Crown. Winning all three races in the same year is so physically grueling that no horse had done it since 1978. Most people in the stands had never seen a Triple Crown winner. Many said it could no longer be done.

American Pharoah in this year's Belmont Stakes in New York.

VICTORY

PHAROAH OR PHARAOH?

No, we didn't misspell: When a thoroughbred horse is born, its owners must submit paperwork to the Jockey Club, which registers the horse and approves its name. The horse American Pharoah was named in part after ancient Egyptian kings called pharaohs. But the horse's paperwork was submitted with incorrect spelling: The *a* and *o* were accidentally swapped. The horse will go down in history as American Pharoah.

HORSE HERO

"The crowd was crazy that day. The stadium was rumbling," says 23-year-old Justin Zayat of New Jersey, whose family owns American Pharoah. "Everyone was rooting for the same horse. Everyone wanted the Triple Crown." As American Pharoah charged forward on the 2.4-kilometer (1.5-mile)-long course, his owners realized that they were about to make history. "Once he takes the lead, he puts his ears up, his head down, and gallops effortlessly," says Zayat. "When I saw that at the first turn, I knew he'd win."

It was over in 2 minutes and 26 seconds. American Pharoah won easily—way ahead of the runner-up. "People were jumping up and down and crying," says Zayat. "I was so proud of the horse."

BEATING THE ODDS

But science suggests that American Pharoah never should have won the Triple Crown. The races

NO TIME TO REST

The three races required to win the Triple Crown are very close together. This makes it really difficult for horses to physically recover between competitions. Only 12 horses have won the Triple Crown since 1875, the first year the Kentucky Derby, the Preakness, and the Belmont Stakes were all held.

are scheduled so close together that it's extremely difficult for a horse to recover between events (*see No Time to Rest, above*). Some trainers have their horses skip the Kentucky Derby or the Preakness so they're in top shape for the Belmont. That puts horses trying to win all three races at a huge disadvantage.

Thoroughbreds can run more than 64 kilometers (40 miles) per hour, but the high speeds take a toll on their bodies (*see Anatomy of a Racehorse, right*). During a tough workout, horses use a lot of energy. Energy is stored in their muscles and liver as *glycogen*, a type of sugar that the body can easily burn for fuel. But using up glycogen leaves them feeling drained.

Your body works the same way. If you've ever suddenly felt tired during a workout, your body was probably running out of glycogen. Distance runners can refuel with sports drinks, but horses don't have time to recharge during a two-minute race.

The horses' muscles also work against them. As horses race, their muscles produce a chemical called *lactic acid*. If tissues become too acidic, the body has trouble breaking down glycogen into fuel, says Clair Thunes, a horse nutrition expert who teaches at the University of California at Davis. That means that as horses run out of fuel, they also have a harder time processing the fuel that remains—and their bodies start shutting down before the finish line.

After a race, lactic acid in a horse's muscles decreases and the animal's body naturally begins to restore glycogen reserves. In humans, restoring glycogen takes about 24 hours. But horses take several days to recover. Trainers make sure horses drink a lot of water to speed up the repair process.

WINNERS: Justin Zayat (*left*) and Victor Espinoza, the jockey who rode American Pharoah, hold up the Triple Crown Trophy.

BLOODY RACE

Refueling isn't the only challenge racehorses face. Any horse that runs at great speeds is at risk of bleeding into its lungs. This can make the horse uncomfortable. At worst, it can cause inflammation, scarring, or even death. The bleeding happens because of the microscopic distance between a horse's lungs and *capillaries*, tiny blood vessels that transport oxygen throughout the body. Horses have very high blood pressure in their capillaries. "Combine that with the pounding of their hooves hitting the ground, and the capillaries can rupture and release blood," says Thunes.

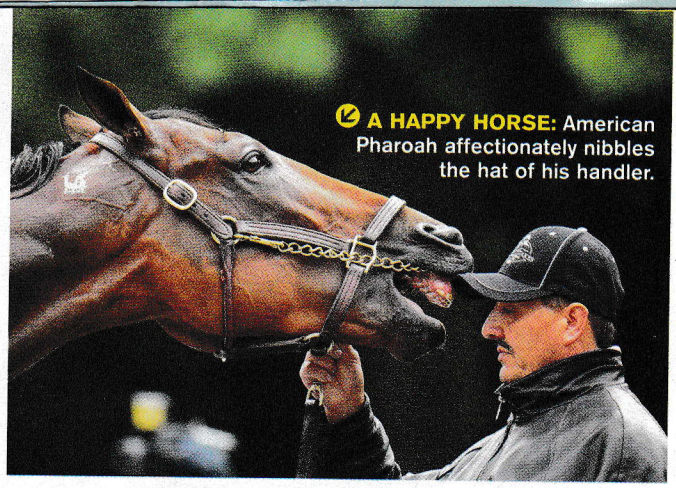
To prevent bleeding, in the 1970s many trainers began giving their horses a drug called Lasix, which lowers the amount of fluid in the body by making a horse pee a lot. This decreases blood pressure and reduces the chance of bleeding. The dropped water weight from peeing adds another benefit—it allows the horse to run faster.

"You're not supposed to use [Lasix] unless a horse has a history of bleeding. But since it also makes them lighter, it gives them an advantage," says Thunes. "So a lot of racehorses are given it." American Pharoah and most other thoroughbreds in the U.S. are given the drug.

But Lasix also causes a horse to lose 40 to 50 times more calcium, sodium, and other minerals than usual. Calcium helps bones heal, so having less of it means it's harder for the horse to

recover from a race. This could put an animal at higher risk of serious injury. And horses on Lasix don't feel thirsty enough to replace the fluids they lose. It takes a horse on Lasix three days to return to its pre-race weight and for its muscles to recover.

Some experts say it's no coincidence that there hadn't been a Triple Crown winner since about the time Lasix became popular. That is, until American Pharoah came along.



A HAPPY HORSE: American Pharoah affectionately nibbles the hat of his handler.

HEART OF A CHAMPION

Justin Zayat says that American Pharoah has an unusual drive to compete. But what really stands out is how sweet he is. "He's not aggressive. He's really a pet," says Zayat.

Ultimately, that mix of characteristics might have won him the Triple Crown. "Ideally, you want the perfect combination of physical traits to make a horse's job easier. But at the end of the day, you need to have trainability and you need to have heart," says Thunes. "Look at American Pharoah's eyes. He looks relaxed and content."

After American Pharoah won, "a lot of commenters on social media said 'Take that, science!'" says Thunes. "I replied that it's not that science was wrong. It's that this is an absolutely amazing horse." —*Amy Barth*

CORE QUESTION

What are three things that made it unlikely that American Pharoah would win the Triple Crown? Cite evidence from the text.

ANATOMY OF A RACEHORSE

Horses evolved to outrun predators. Thoroughbred horses are carefully bred for qualities that make them the fastest among horses.

1. RESPIRATORY TRACT
This is where air comes in. Some racehorses wear nasal strips (bandages that keep nasal passages open) to allow for easier breathing.

2. LUNGS
Horses have 18 ribs compared with our 12, allowing for a gigantic chest cavity for their lungs. Galloping horses breathe in and out 140 times per minute. Humans take about 40 breaths per minute when exercising.

3. GUTS
When a horse raises its legs and head to run, its guts slide backward, making space for air to enter the lungs. When the horse lands, its head drops and its guts slide forward, pushing air out. This helps horses quicky take in huge volumes of air.

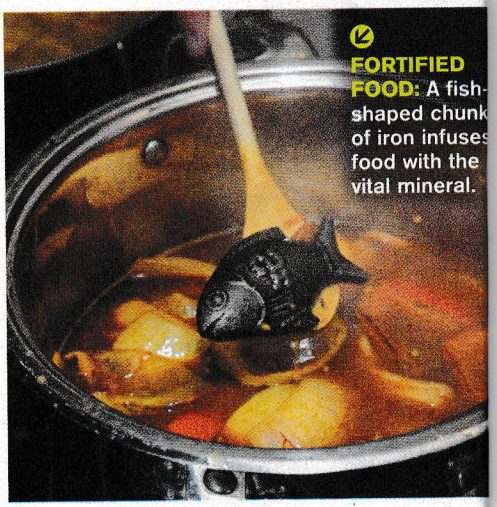
4. BONES
At times, a galloping horse puts all its weight on one leg. That limb bears three times more weight than usual. On a turn, the stress is even greater. Bones become stronger and thicker over time to protect the horse.

5. MUSCLES
Slow-twitch muscles specialize in using oxygen efficiently, which helps horses run quickly for longer. Thoroughbreds have nearly twice as many slow-twitch fibers as quarter horses, which excel at short sprints.

6. HEART
A thoroughbred's heart is 10 percent bigger than those of other horse breeds. The heart of a famously fast thoroughbred named Phar Lap weighed a hefty 14.1 pounds.

LIFE-CHANGING FISH

This cute iron fish could help solve a health crisis in developing countries



FORTIFIED FOOD: A fish-shaped chunk of iron infuses food with the vital mineral.

WATCH A VIDEO
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4 BONUS SKILLS SHEETS
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As a graduate student in Ontario, Canada, Christopher Charles traveled to Cambodia. He was studying population science and decided to move to a remote village to observe the Khmer (keh-MEHR) people there. When Charles arrived in 2008, he immersed himself in the villagers' culture.

He lived in a typical home—one that was raised above the ground on bamboo stilts and had a tin roof, but had no electricity and no running water. He slept in a bed covered by a mosquito net to keep disease-carrying insects away, and ate simple, low-fat meals of rice, fish, and pickled vegetables.

"One of the things I noticed about the youth in Cambodia was how seemingly fit they were, with bulging muscles and no fat," Charles says. But it wasn't long before he observed a disturbing health trend and decided to investigate.

Even though people looked healthy and strong, Charles saw that many of them behaved as if they were sick—cooped up in their homes and sleeping in the middle of the day. Schools had few students, and those in attendance looked fatigued, with little energy to learn or concentrate.

Charles recognized the culprit: *anemia*. People with this blood condition have a

reduced number of red blood cells in their bodies. Red blood cells contain an iron-rich protein called *hemoglobin*, which carries oxygen from the lungs to other tissues in the body. If a person doesn't have enough red blood cells, organs don't get enough oxygen and therefore don't work efficiently. The person begins to feel run-down.

About 2 billion people around the world suffer from anemia, according to the World Health Organization. In the villagers' case, their anemia is from a lack of iron in their diet, called *iron deficiency anemia*. A 2005 study found that more than 67 percent of Cambodian children suffered from anemia.

The villagers' diet of primarily rice and fish is low in iron. Red meat—the best source of iron—is uncommon in developing countries like Cambodia because raising cattle is expensive. Villagers could take iron *supplements*, but many people prefer not to because the pills can upset digestion.

The iron our body needs is the same type as the metal found in cast-iron cookware. People can fortify their food with iron by cooking in a cast-iron pot. However, these pots are expensive and heavy, and they rust easily. Still, this gave Charles an idea.

He melted scrap iron into bricks called *ingots*. He then tried to convince the villagers to cook their food with the bricks.

But because the ingots looked unappealing, people used them as doorstops and paperweights. So Charles tried a new design: a fish—a favorite Cambodian food and a symbol of happiness or luck. He delivered the Lucky Iron Fish to villagers. It was a success—92 percent of the people used it.

Charles studied about 250 villagers for a year. Those who used the Lucky Iron Fish were about 25 percent less likely to be anemic than those who didn't use one. Blood tests also showed that levels of both hemoglobin and *serum ferritin* (a protein that indicates iron levels in the body) rose over time (*see graphs below*).

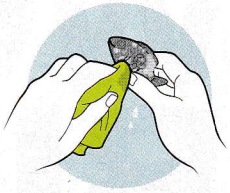
Today about 10,000 Cambodian families are using the Lucky Iron Fish, and anyone can purchase one online to boost the iron in their diet.

—Andrew Klein

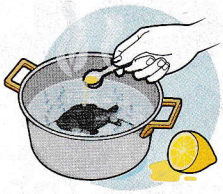
CORE QUESTION

Why was the Lucky Iron Fish successful at lowering anemia in the villagers? Why did previous methods fail?

HOW TO COOK WITH THE LUCKY IRON FISH



STEP 1: Clean the metal fish.



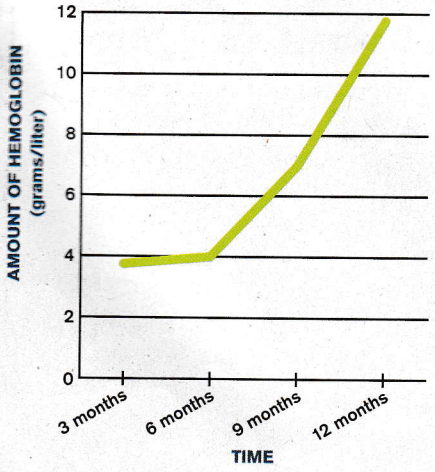
STEP 2: Put the fish in boiling water. Add a teaspoon of citrus (such as lemon) juice—acidity releases more iron from the lucky fish and also helps the body absorb more iron. Remove the fish after 10 minutes.

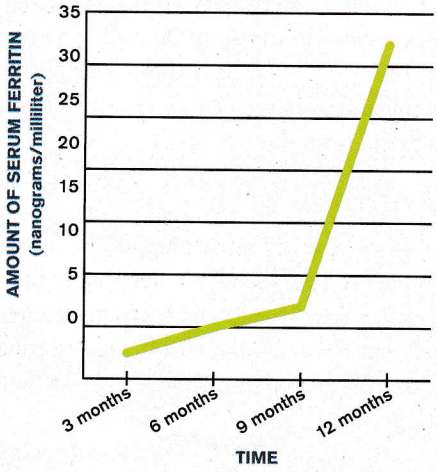
STEP 3: Add ingredients to the pot.

STEP 4: Enjoy iron-fortified food. Replace fish after five years, or once the fish's smile fades away.

BLOOD MARKERS IN LUCKY IRON FISH USERS

How did anemic villagers' hemoglobin and serum ferritin levels change during a year of using the fish?





SOURCE: CHRISTOPHER CHARLES

THE WORLD'S BIGGEST SHIPS

Inside the incredible race to dominate the high seas

Think about some of the things you use every day: Your clothes. Your shoes. Your phone or computer. Most of these items were manufactured overseas—and they probably traveled to the U.S. by ship.

We live in an era when planes whisk passengers between continents in a few hours, so it may surprise you to learn that 90 percent of the world's goods still move by sea. Maritime shipping remains the cheapest and most efficient way to transport mind-boggling amounts of stuff all over the globe.

Most consumer goods are shipped in *containers*, giant metal boxes that can be picked up by cranes and loaded directly onto trucks or trains when a ship gets into port. Thousands of container ships shuttle these reusable boxes around the world. A single vessel might carry half a billion dollars' worth of clothing, electronics, food, and other products. The more containers a ship can transport on each voyage, the more profitable it is for its owner—which means shipping companies are racing to build ships that are bigger than ever before.

WATCH A VIDEO
scholastic.com/scienceworld

4 BONUS SKILLS SHEETS
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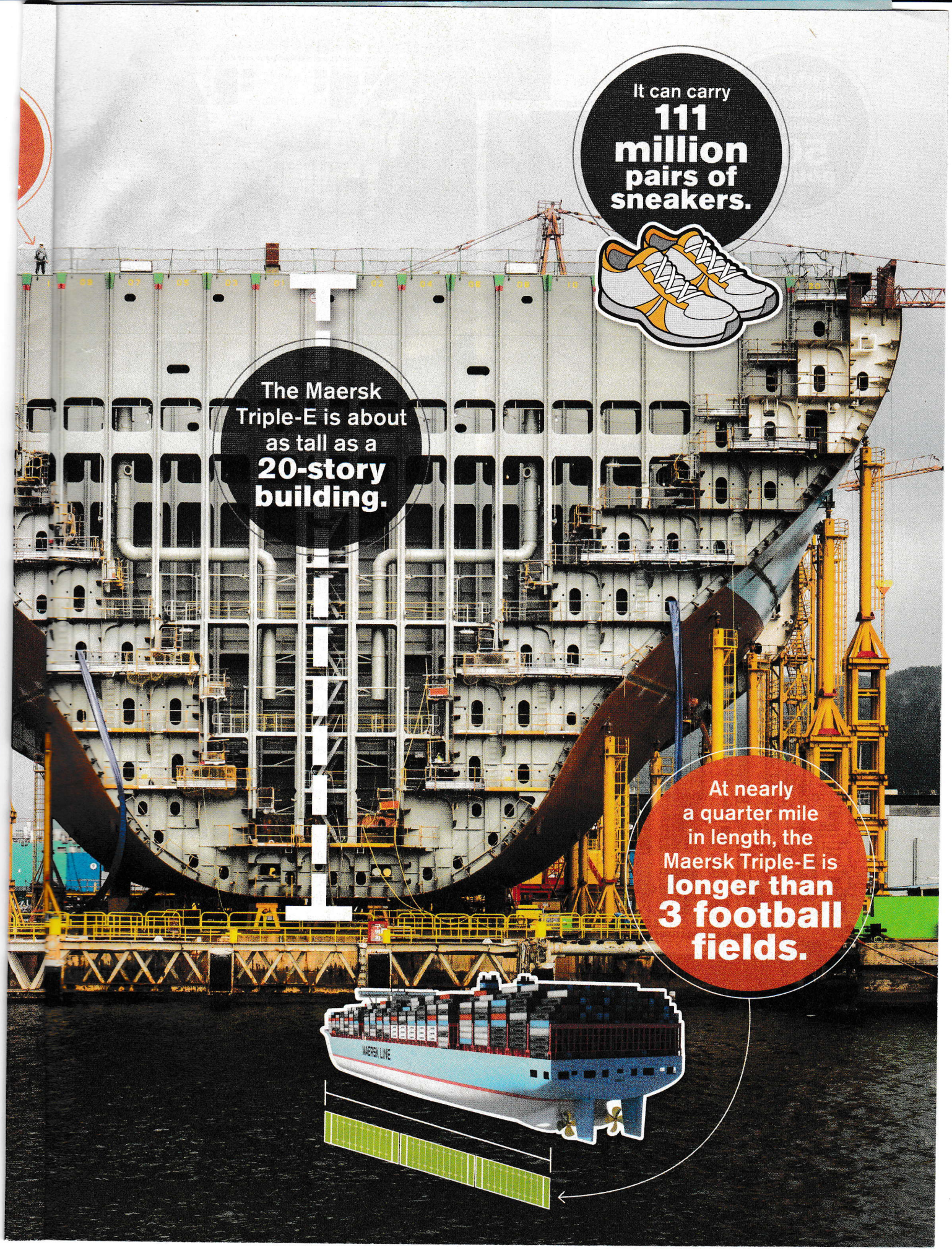
A NEW GENERATION

About five years ago, Danish shipping company Maersk decided to take container shipping to the next level with a new vessel. The company wanted a behemoth that could cut the cost of transporting each container by 30 percent while using less fuel than existing ships.

Continued on p. 16


It can carry
111
million
pairs of
sneakers.
The Maersk
Triple-E is about
as tall as a
20-story
building.
At nearly
a quarter mile
in length, the
Maersk Triple-E is
longer than
3 football
fields.
MAERSK LINE

Each link in the Triple-E's anchor chain weighs around **500 pounds.**

Each Triple-E costs about **$190 million.**

The Maersk team created a wish list hundreds of pages long detailing what they wanted. They took it to the world's biggest shipyards, which proposed various designs. Maersk selected their favorite design, from Daewoo Shipbuilding & Marine Engineering in South Korea. Then naval architects and engineers from both companies worked together to finalize the plans.

Michael Heimann, Maersk's project manager, says the team realized that one way to cut fuel consumption is to sail more slowly. Then the engine doesn't have to work as hard, and there are additional fuel savings from reduced *drag*, or water resistance.

Slower speeds opened up new design possibilities. "We were able to make the *hull* [the ship's frame and body] wider and more bathtub-shaped, which helps with packing in more containers," says Heimann.

Another big change came in the *propulsion* system. Maersk's lead naval architect, Troels Posborg, realized that having two smaller engines and two propellers instead of the usual one of each would be more efficient. Twin engines and propellers can spin more slowly and use less fuel than a single big engine and propeller to achieve the same ship speed. "That was a quantum leap for container vessels," says Posborg.

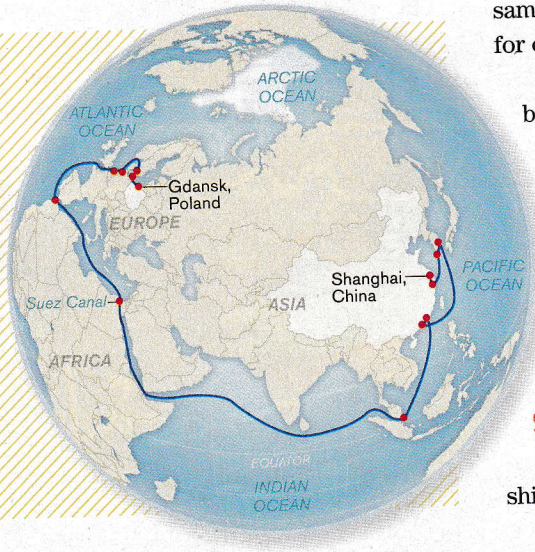
Once the design was drafted, the builders used computer simulations to test its stability. They modeled different distributions of cargo and rough ocean conditions that can put added stress on the hull. In 2012, the blueprints for the new vessel, called the Triple-E, got the final thumbs-up. It was time to build the world's biggest ship.

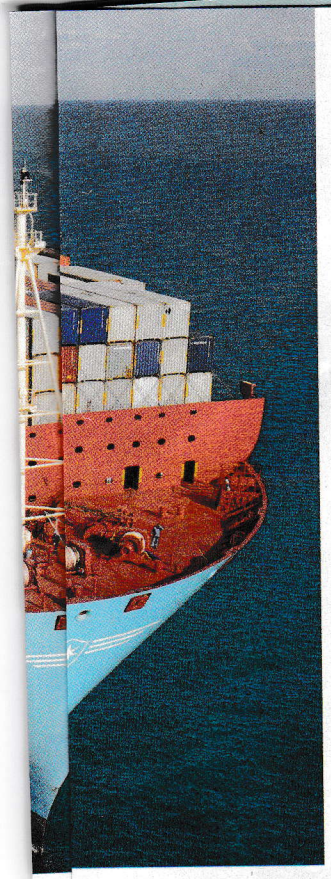
STEEL GIANT

The main ingredient in a container ship is steel. The Triple-E contains more

THE ASIA-EUROPE ROUTE

The world's largest ships sail this route between Asia and Europe. Those vessels are too big for U.S. ports, so goods come here on smaller ships.





than 50,000 tons of it—enough to build eight Eiffel Towers. Steel is an *alloy*, or mixture, of iron and other elements, especially carbon. For the Triple-E, the shipbuilders ordered steel mixed to their exact specifications from a mill near the yard in South Korea. They needed just the right recipe to make the steel tough enough to withstand brutal waves. Steel that's too brittle can crack under the strain and sink a ship.

At the shipyard, automated machines called plasma cutters used gas superheated to 16,000°C (29,000°F) to slice the steel. Robots *welded* the cutouts, joining them together by melting the edges, to form giant segments of the hull called *megablocks*—24 in all. A crane lifted the finished megablocks into place, and another set of welding robots melted them together to complete the hull. Maersk engineers checked the strength of the welds in a lab—testing how much energy was required to bend, stretch, and break them—to make sure the joints would hold.

The shipbuilders wrapped up the paint job, installed the pair of 43,000-horsepower engines and two 70-ton propellers, and completed the electrical wiring and controls. The Triple-E was ready for its first test at sea.

TITANS OF THE WAVES

The first Triple-E class ship—400 meters (1,312 feet) long, weighing nearly 60,000 tons, and able to carry more than 18,000 containers—passed its sea trials with flying colors. In July 2013, it set off on its maiden voyage (*see map, left*). Since then Maersk has built 19 sister ships of the same type.

There are many places the Triple-E can't sail because of its enormous size. "The most limiting constraints are ports and waterways," says Jaye Falls, a naval architect with the U.S. Naval Academy. Some passages are too narrow or shallow for such colossal ships (*see Panama Canal Expansion, below*). Many ports don't have cranes large enough to reach across the biggest ships, adds naval architect Paul Miller, also of the Naval Academy. And even on the open ocean, the limited strength of materials like steel puts constraints on designs for ever-larger vessels, says naval architect Matthew Werner of the Webb Institute in New York.

Despite these limits, the Triple-E didn't hold the title of world's biggest ship for long. In late 2014, China Shipping Container Lines launched the *Globe*, with a capacity of 19,100 containers. Then this year, the Mediterranean Shipping Company's *Oscar* headed to sea, setting a new record at 19,200. Its owners and crew had better enjoy the title while it lasts: Shipbuilders are building the next seagoing monsters—able to carry more than 20,000 containers—right now.

—Jennifer Barone

CORE QUESTION

What are two ways the Triple-E's designers maximized efficiency in the new ship? Cite evidence from the text.

PANAMA CANAL EXPANSION

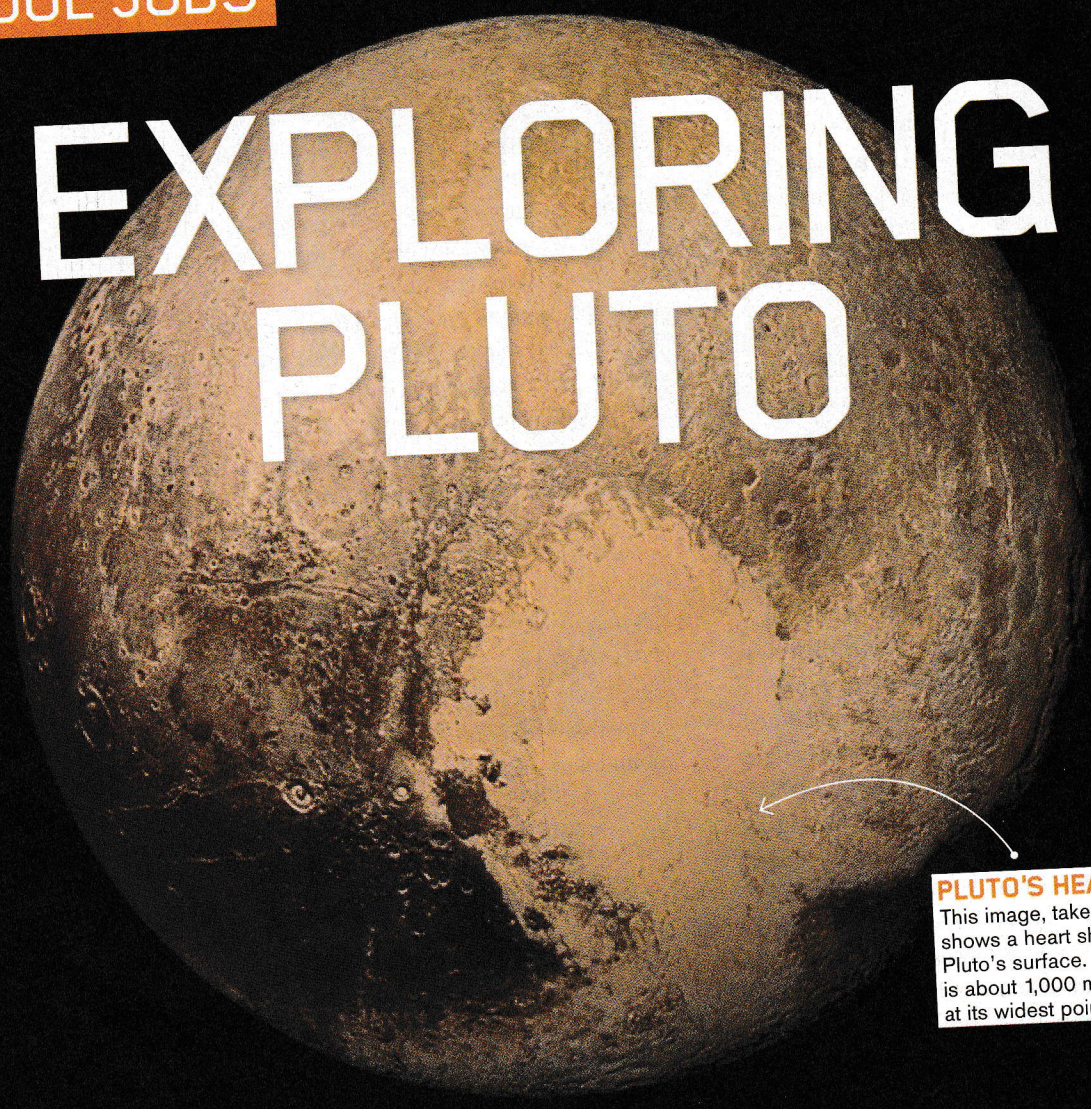
The Panama Canal, an 80 km (50 mi) waterway in Panama that allows ships to pass from the Atlantic to the Pacific without sailing all the way around South America, is expanding to accommodate much larger vessels. Even so, the world's biggest ships will still be too big!

A new, even bigger canal proposed in Nicaragua could allow passage of these giants, but it's not yet clear whether the project will move ahead. It might displace thousands of people who live along the canal's route and could have negative environmental impacts.

OPEN UP! The Panama Canal will soon be wider and deeper.

COOL JOBS

EXPLORING PLUTO



PLUTO'S HEART This image, taken on July 8, shows a heart shape on Pluto's surface. The heart is about 1,000 miles across at its widest point.

Physicist Alice Bowman steered a spacecraft to Pluto

On July 14, a NASA spacecraft called New Horizons flew within 12,500 kilometers (7,800 miles) of Pluto's icy surface—closer than any other human-made object. It sent back the best images ever taken of Pluto.

Pluto is a *dwarf planet*. It's much smaller than a planet, but it is round and orbits the sun just like the eight regular planets in our solar system. Pluto is part of the *Kuiper belt*, a region at the very edge of our solar system. New Horizons is the first spacecraft to explore this area. The mission could reveal what Pluto and other Kuiper belt objects are made of and what space is like far from the sun.

DRIVING THROUGH SPACE: Alice Bowman at the New Horizons Mission Operations Center in Maryland

The Pluto flyby was only nine days long, but it took 14 years of preparation. That includes more than nine years of guiding the spacecraft abou 5 billion kilometers (3 billion miles) to Pluto.

As the mission's operations manager, physicist Alice Bowman makes su New Horizons runs smoothly. She spoke wi *Science World* about what it's like to fly the

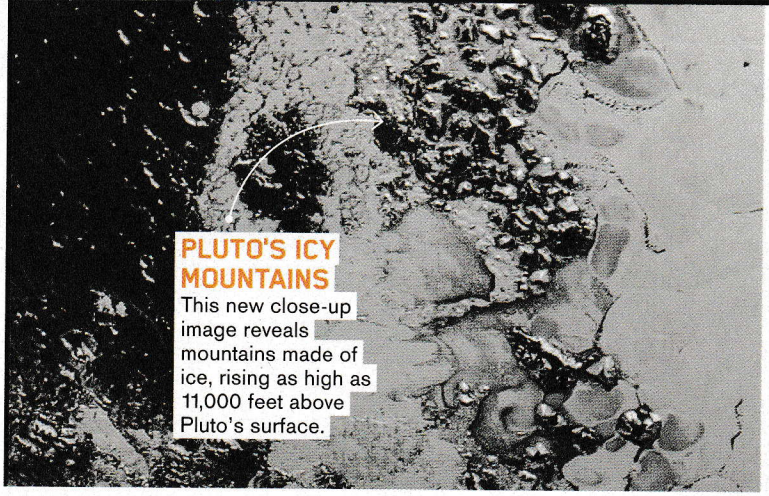
craft through the vast emptiness of space and get closer to Pluto than ever before.

Why did you want to be a part of this mission? Who wouldn't want to work on a mission to Pluto? I had always worked on spacecraft that orbited Earth, but I really wanted to explore other planets. There are so many things New Horizons is going to discover, like whether Pluto has an ocean or if there's geological activity shaping Pluto's surface. To be part of that mission is amazing.

What's it like to operate a spacecraft? It's a team effort. I work with scientists like planetary geologists to make sure we get the observations we want. I also work with engineers to make sure the spacecraft is in good shape to make those observations.

My team writes all the commands to control the craft, telling it to do things like turn right or take pictures. We send the commands using radio waves from huge antennae here on Earth.

What has been challenging so far? Pluto is so far away. From the dwarf planet, the sun is just a dim point in the sky. It takes 4.5 hours for our commands to get to New Horizons. So when we're aiming radio waves to the craft to communicate with it, we have to aim to where the craft will be in 4.5 hours.



PLUTO'S ICY MOUNTAINS This new close-up image reveals mountains made of ice, rising as high as 11,000 feet above Pluto's surface.

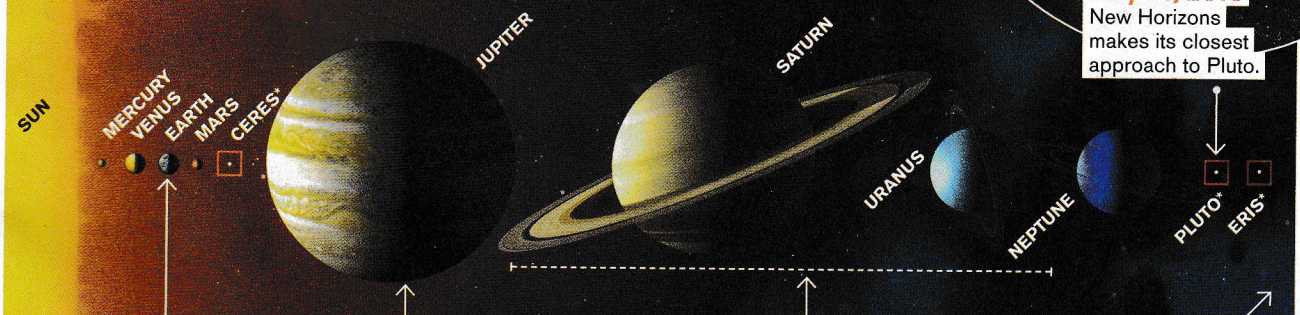
It takes the same amount of time for us to receive data back from New Horizons. So if something goes wrong—like the computer crashes—I wouldn't know it for 4.5 hours! Luckily, nothing major has gone wrong.

What was it like when New Horizons flew by Pluto? We felt like champions. Getting the signal that we'd passed Pluto safely was the best. The control center was full of engineers cheering.

The flyby revealed that Pluto has icy mountains as tall as the Rockies. The dwarf planet and its moon Charon look completely different from each other, which may disprove one theory that Charon used to be a part of Pluto. We'll be looking at data from the flyby for years to come. —*Lydia Chain*

NEW HORIZONS' TIMELINE

After 9.5 years of traveling through space, New Horizons flew by Pluto in July.



Jan. 19, 2006 The craft launches from Cape Canaveral, Florida.

Feb. 28, 2007 New Horizons flies by Jupiter.

2007 to 2014 For most of the eight-year trip from Jupiter to Pluto, the craft is in sleep mode. In December 2014, it is awakened for the Pluto flyby.

July 14, 2015 New Horizons makes its closest approach to Pluto.

Into the Future The craft may go on to explore other objects in the Kuiper belt, at the edge of our solar system.

*DENOTES A DWARF PLANET

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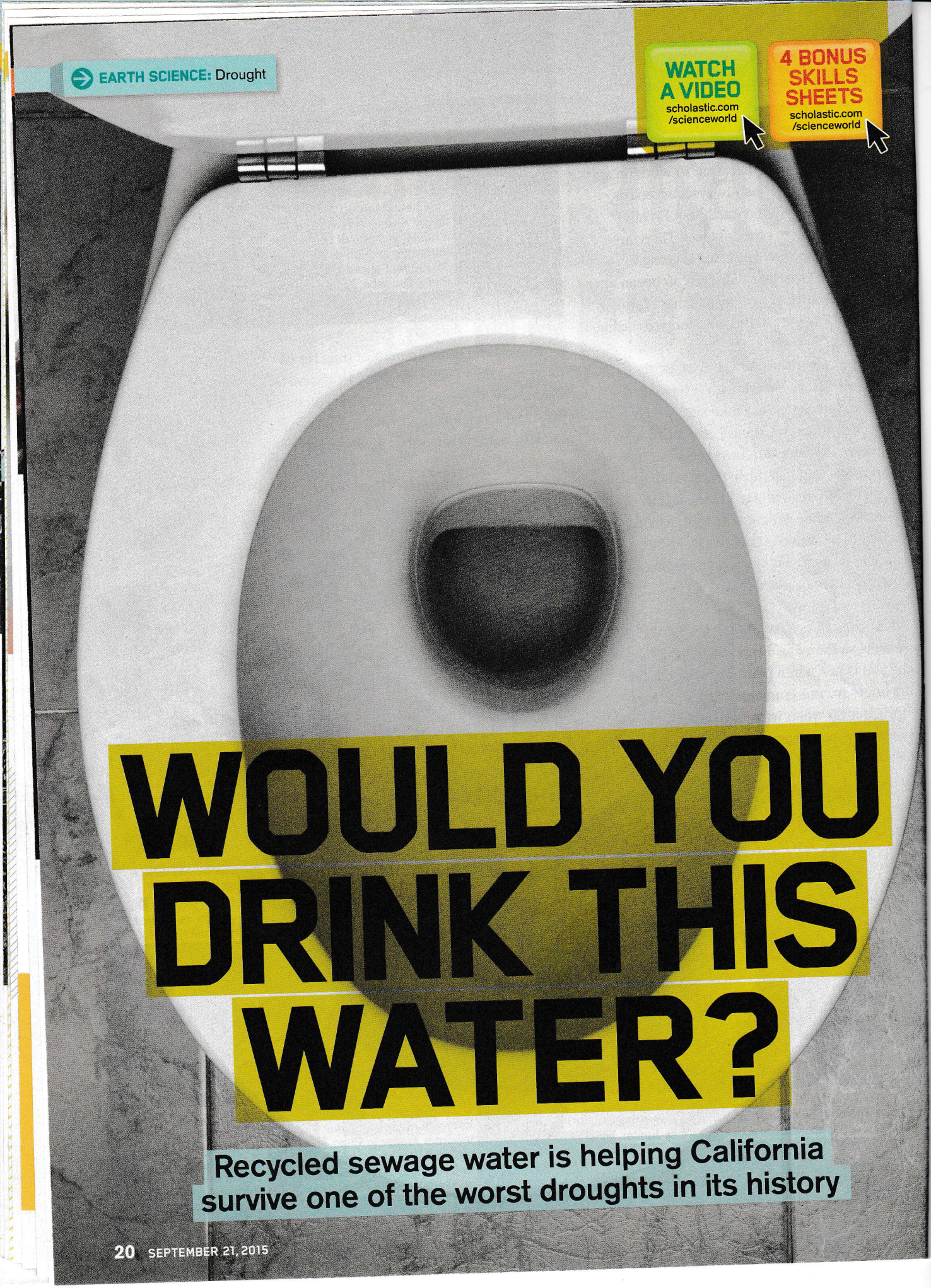


WOULD YOU DRINK THIS WATER?

Recycled sewage water is helping California survive one of the worst droughts in its history

A historic drought is crippling California. A third of the nation's fruit, vegetables, and nuts come from the state's Central Valley, so it's a problem that affects us all. Governor Jerry Brown has ordered cities and towns to cut water usage by 25 percent. And officials say it's more important than ever to recycle water—even the water used to flush the toilet.

BONE DRY

Last year was the warmest and the third driest recorded in California in the past 119 years, according to Laurel Rogers of the U.S. Geological Survey's California Water Science Center.

The Arangio family recently moved to Santa Clara County in Northern California, and they see signs of drought all around them. "Rivers are dry," says Lily Arangio, 10.

"Some people think it's awful if you water your lawn," says her sister Caroline, 12.

The state has received only two thirds of the usual amount of precipitation over the past three years. And this year scientists discovered that the spring *snowpack* in the Sierra Nevada Mountains was down to just 5 percent of the normal amount. Snowpack consists of layers of snow that accumulate in high, cold places during the winter. As California's snowpack slowly melts during the spring, it becomes an important source of water for the entire state.

"During the drought, people are relying much more heavily on *groundwater*," says Rogers. Groundwater is water that collects below Earth's surface. About 40 percent of California's drinking-water supply comes from groundwater. In the Central Valley, where pumping from underground sources isn't regulated, farmers have drawn so heavily on groundwater that the entire valley has started to sink. This *subsidence* happens when *aquifers*—layers of rock that absorb and hold water—are emptied out and start to compress. The sinking of the land can damage roads, bridges, and buildings.

In the more populous southern part of the state, engineers have developed a way to recapture the water flushed down hundreds of thousands of toilets in Orange County, near Los Angeles. They purify it and send it back to the drinking-water supply.

ULTRA PURE: Part of the filtration system at a water recycling plant in San Jose, California

WASTE WATER RECYCLING

$481 MILLION
cost to build original plant in Orange County, California

2.3 MILLION
number of people served

45 MINUTES
time for water to travel through the plant

"We were looking for a drought-resistant supply of water," says Mehul Patel, the program manager for the Orange County Groundwater Replenishment System—the facility responsible for making the water from toilets clean enough to drink.

TOILET TO TAP

How does the county's water go from toilet to tap? First the sewage department captures wastewater from toilets, sinks, and showers. It runs the water through a standard sewage treatment plant, where it comes out clean enough to be dumped into the Pacific Ocean.

But rather than put the treated water out to sea, workers send it through an elaborate system of pipes, filters, and tanks, where it undergoes a purification process. Sophisticated filters trap large contaminants (like most bacteria) and remove salt, prescription drugs, and other unwanted chemicals that may be lurking in the water. Then ultraviolet light and hydrogen peroxide kill any remaining bacteria, viruses, or other living contaminants.

The purified water is carefully checked for safety. The treated water is actually so pure that minerals have to be added in for flavor, because without them it's too bland.

After the steps are completed, about 40 percent of the purified water is injected into

DOING DISHES
Save water by clearing your plate with a fork and your napkin before washing. Use dirty dishwater to water houseplants or gardens.

FAKE LAWN
Some Californians are installing artificial grass that never needs watering.

the ground near the coast. That stops water levels from dropping too low in the groundwater basin there. If those water levels were allowed to fall too far, salty Pacific Ocean water could flow in and ruin the supply of fresh water that many people rely on.

The rest of the purified water is pumped into lakes. The water slowly seeps down through layers of clay and rock and eventually ends up in the groundwater, helping to replenish the drinking-water supply.

A SCARY FIRST SIP

There's no denying it: The idea of downing water that started out in your toilet takes some getting used to.

Getting the first "toilet to tap" plant built in Orange County back in 2008 was difficult. Another California city, San Diego, blocked construction of a similar plant because people were disgusted by the idea of drinking water that once contained poop.

But since 2008, California's drought has gotten more severe. And many people in Orange County have safely consumed the purified wastewater for the past seven years. Patel says those factors are helping area residents get onboard with water recycling.

The water recycling plant in Orange County recently expanded from 70 million gallons a day to 100 million gallons. The once-protested plant in San Diego is back on track and could be recycling 30 million gallons of water a day by 2021. New water recycling plants are also being constructed in Arizona and Texas.

THE TREATED WATER IS SO PURE THAT MINERALS HAVE TO BE ADDED IN FOR FLAVOR.

A wastewater recycling plant has been proposed near the Arangio family's new home, so they may get a chance to drink recycled water in the future. Like many California residents, Lily Arangio thinks the idea of toilet to tap is "gross" but also brilliant. "I'd be brave enough to give it a try," Lily says.

After California's successful water recycling efforts, other states are facing less of the dreaded "yuck factor." In the Texas cities of Wichita Falls and Big Spring, facilities even send water from the recycling plant to a water treatment plant and then directly into the water supply—skipping the trip through the underground aquifers.

Patel thinks that's a natural next step for California, too. The only reason recycled water in California is pumped into the aquifer is that state law requires it, not because the trip makes the water any cleaner or safer, Patel says. "Pipe to pipe may need to be a reality in the future," he says.

—Emily Costello

CORE QUESTION

What steps are involved in purifying wastewater to make it clean and safe to drink?

QUICK WASH
Stick-on timers remind users not to linger in the shower.

FROG IN YOUR THROAT?

Photographer Nicolas Reusens was trekking through the jungle in the Central American nation of Costa Rica when he stumbled upon a surprising scene: a snake eating a live frog! He says that it took about two minutes for the snake to swallow the frog whole.

"It was a moment of life and death," says Reusens. "Cruel, raw, but also an example of what happens every day in nature."

The snake, a black forest racer, is nonvenomous, will grow to about 1 meter (3 feet) in length, and has an unusual diet—mostly frogs.

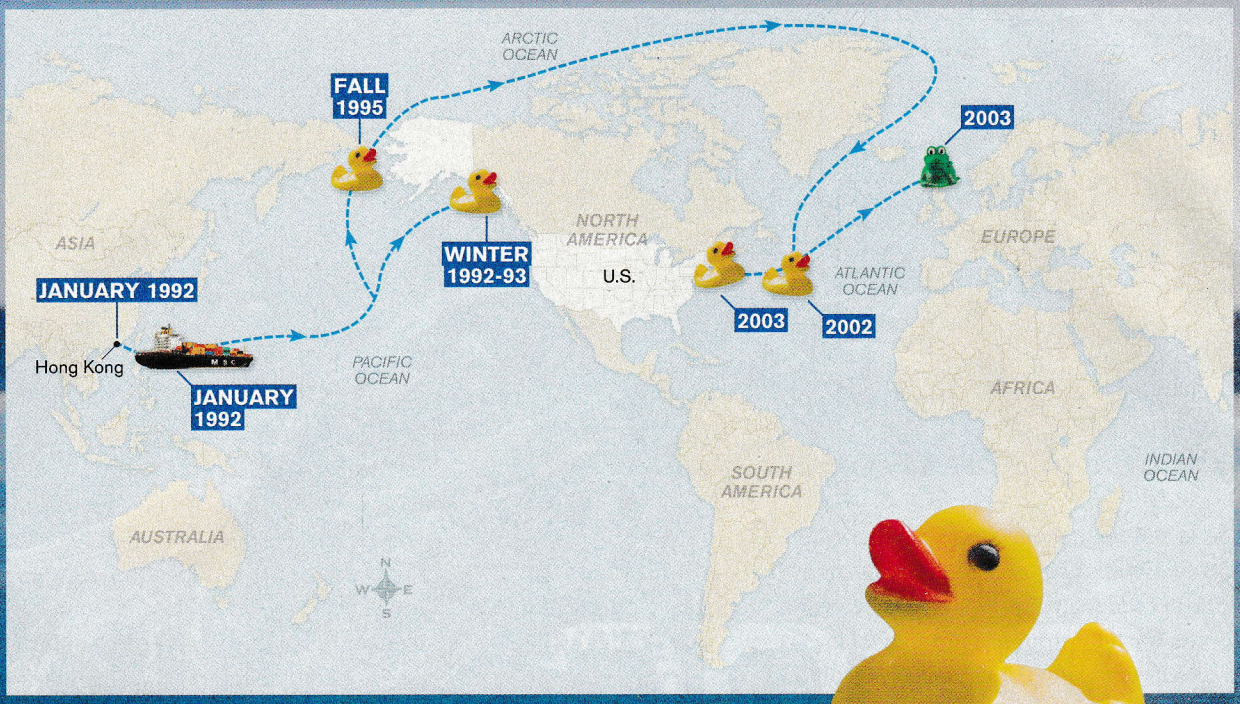
It's rare for a snake to specialize and eat just one kind of animal, says Frank Indiviglio, a herpetologist who has studied reptiles and amphibians at several New York City zoos. Most species are *generalists*—they eat just about anything. Depending on a snake's size, a meal can range from tiny ants to a large mammal. "I've seen an anaconda eat a 60-pound deer," says Indiviglio.

Snakes have double-hinged jaws that allow them to open their mouths extremely wide. As a result, they can swallow prey whole, even animals two to three times the size of their heads.

A snake's stomach is also much more acidic than a human's. This allows it to absorb as much of the nutrients from its prey as possible. It then regurgitates parts of the animal—like hair, fur, hooves, and thick bones—that are too tough to digest. In the case of the frog in this photo, everything but its hip bones was probably absorbed, says Indiviglio.

—Kathryn Free

INTERPRETING VISUALS



DUCKS AHOY!

In "The World's Biggest Ships" (p. 14), you learned about container ships. About 2,500 containers are lost at sea every year. In 1992, a container of bath toys made in China—28,800 plastic ducks, turtles, beavers, and frogs—fell into the Pacific. The map above highlights the toys' journey as currents carried them around the globe.

JANUARY 1992: Ship departs Hong Kong.

JANUARY 1992: Toy-filled container washes overboard in a storm.

WINTER 1992–93: More than 100 toys are found in southeastern Alaska.

FALL 1995: Thousands of toys are spotted in the Bering Strait.

2002: Two toys are seen near the site where the *Titanic* sank.

2003: A lone plastic frog is found on a beach in Scotland.

2003: A duck is found on the coast of Maine.

ANALYZE IT: Oceanographers tracked reports of the floating toys for many years. How might the toys' travels be valuable for scientists to study? What might researchers learn?

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